Amendments to the Drawings

The replacement sheets of drawings attached hereto as **Exhibit A** include changes to, and replace, Figures 1 and 6 of the original sheets of drawings. The labels for elements 102, 103, 106, 104 and 702 in Fig. 1 have been corrected. Labels have been added for "Display Field Area", "Probe Tip Region", "Gaster Wall" and "Gaster Wall Blood Vessel Running" in Fig. 6.

Attachment: replacement sheets of drawings for Figures 1 and 6

REMARKS

The application has been reviewed in light of the Office Action dated November 4, 2006. Claims 1-13 were pending. By this Amendment, claims 3 and 5 have been deleted, without prejudice or disclaimer, claims 1, 2, 4, 6 and 11 have been amended to clarify the claimed subject matter, and new claim 14 has been added. Accordingly, claims 1, 2, 4 and 6-14 are now pending, with claims 1 and 2 being in independent form.

The drawings were objected to as having informalities. The specification was objected to as having informalities.

The drawings and specification has been reviewed and amended to correct the formal matters noted in the Office Action.

The replacement sheets of drawings attached hereto as **Exhibit A** include changes to, and replace, Figures 1 and 6 of the original sheets of drawings. The labels for elements 102, 103, 106, 104 and 702 in Fig. 1 have been corrected. Labels have been added for "Display Field Area", "Probe Tip Region", "Gaster Wall" and "Gaster Wall Blood Vessel Running" in Fig. 6. The labels for elements 102, 103, 106, 104 and 702 in Fig. 1 have been corrected. Labels have been added for "Display Field Area", "Probe Tip Region", "Gaster Wall" and "Gaster Wall Blood Vessel Running" in Fig. 6.

Withdrawal of the objection to the drawings and the objection to the specification is respectfully requested.

The oath/declaration was objected to as purportedly defective (for failing to set forth the mailing address or post office address of each inventor).

An Application Data Sheet for this application, with the mailing address of each inventor, is attached as **Exhibit B** hereto.

Claim 6 was rejected under 35 U.S.C. §112, second paragraph, as allegedly indefinite.

In response, the claim has been carefully reviewed and amended with particular attention to the point raised in the Office Action.

Withdrawal of the rejection under 35 U.S.C. §112, second paragraph, is respectfully requested.

Claims 1, 2 and 6-9 were rejected under 35 U.S.C. § 102(b) as purportedly anticipated by U.S. Patent No. 6,171,248 to Hossack et al. Claims 3-5 and 10-13 were rejected under 35 U.S.C. § 103(a) as purportedly unpatentable over Hossack in view of U.S. Patent No. 5,291,892 to O'Donnell.

Applicant has carefully considered the Examiner's comments and the cited art, and respectfully submits that independent claims 1 and 2 are patentable over the cited art, for at least the following reasons.

This application relates to improvements devised by applicant to an ultrasonic probe that is suitable for inserting into a body cavity and for collecting ultrasonic images of the entire circumference of 360 degrees in the body cavity. The improvements enable the capability of displaying ultrasonic wave images with no positional irregularity and with a high image quality including tomographic images and blood flow images along the entire circumference of the ultrasonic transducers, and permits the medical professional to easily grasp the situation of disease, reduce an amount of time required for diagnosis and enhance diagnostic efficiency as well as reduce a load for the user, easily confirm a disease situation and obtain useful information for confirmed diagnosis.

For example, in one improvement, a connection change over switch is disposed in the handle section, and the connection change over switch is constituted in such a manner that the

respective plurality of the vibrator elements are connectable with any one of a predetermined number of ultrasonic wave transmission and reception channels for transmitting and receiving ultrasonic wave signals in an ultrasonic diagnostic apparatus main body (and therefore the scanning operation by the ultrasonic beams can be performed while fixing the delay times for the respective ultrasonic wave transmission and reception channels unchanged), and the connection change over switch successively changes over electrical connection of a predetermined number of vibrator elements among the plurality of vibrator elements to be connected with the predetermined number of ultrasonic wave transmission and reception channels. Each of independent claims 1 and 2 as amended addresses these features, as well as additional features.

In conventional approaches, the delay times for the respective ultrasonic wave transmission and reception channels have to be changed every time during the scanning by the ultrasonic beams, and therefore complex circuits are typically required.

The claimed subject matter of this application, enables elimination of the cumbersomeness of successively changing the delay times set for the respective ultrasonic wave transmission and reception channels during the scanning by the ultrasonic beams, and accordingly circuits for changing the delay times are not required to be provided at the side of the respective ultrasonic wave transmission and reception channels. Further, since such cumbersomeness is eliminated (and the time required for changing the delay times is saved at the side of the respective ultrasonic wave transmission and reception channels), a high speed acquisition of ultrasonic images can be achieved. In addition, since no circuits for changing the delay times are required to be provided at the side of the respective ultrasonic wave transmission and reception channels, the size of the respective ultrasonic wave transmission and reception channels can be reduced.

In the preferred embodiments of the present application, the connection control circuit 106 which controls the connection change of the respective vibrator elements in the probe with the respective ultrasonic wave transmission and reception channels and therefore the delay times of the respective ultrasonic wave transmission and reception channels can be set unchanged. Further, the switches in the connection change over switch 105 can be flexibly controlled, which enables reduction of circuit size as well as enhancement of switching speed.

Hossack, as understood by Applicant, proposes an ultrasonic probe configured with at least two ultrasonic transducer arrays, including a linear phased array 20 and an annular, radial phased array 22, at the distal end of the probe.

Hossack, column 5, line 50 through column 6, line 32, which was cited in the Office Action, states as follows:

> The system 100 includes a beamformer system/signal detector 102 which includes both transmit and receive beamformers and is connected via a multiplexer/demultiplexer 104 to an ultrasonic probe 10 such as that shown in FIG. 1. If both arrays are operating in a conventional mode where the active transducer aperture is operated simultaneously in a phased manner, then any conventional device--such as the Acuson XP may be used for element 102. If the arrays are being operated in a synthetic aperture mode, i.e., in which the elements of the array are operated in a sequential rather than simultaneous mode, then it is necessary for the system to store the receive element signals in a temporary store until all of the transmit-receive element combinations have been received. Once all the echo signals have been received then the data in the temporary storage registers are delayed and summed to produce a beamformed signal. Systems for implementing this type of synthetic focusing by temporarily storing single channel data until all channel data has been received are well known, for example, see Proudian U.S. Pat. No. 4,917,097. The system preferably accumulates multiple signals for each transmitter-receiver pair so that signal averaging is achieved thereby resulting in an improvement in the signal to noise ratio. Alternatively, instead of using a common transducer element for both transmitter and receiver a separate receiver can be used for each transmitter channel selected. Such a method is described by O'Donnell et al. in "Synthetic Phased Array Imaging of Coronary Arteries With An Intraluminal Array," Proceedings of the 1995 IEEE Ultrasonics Symposium, pp. 1251-1254 (1995). Individual elements are sequentially used as transmitters. As each element is used as a transmitter, separate adjacent elements are used as receivers on a sequential basis. In this way, the array

> can be made to synthesize the operation of a conventional large scale phased array scanner but with the added advantage that dynamic transmit focusing as well as dynamic receive focusing is possible since the individual channel transmit path lengths are known uniquely. The low signal to noise ratio of the array elements is partially overcome by averaging the successive firings of the same element pairs. Preferably, as many averages as possible are used consistent with not providing an imaging frame rate which is slower than desired by the user. Preferably the array is operated with frequencies in the range of about 5 to 10 MHz. If lower frequencies are used, then the linear array has less problems with grating lobes. Alternatively, a lower frequency can be used when operating steered ultrasonic lines as describe in U.S. Pat. No. 5,549,111. When the linear phased array is used to accumulate tracking information, the array can be operated at a high frequency, for example, 10 MHz, since only a relatively small set of data is required in order to derive the motion information.

However, applicant does not find teaching or suggestion in Hossack of an ultrasonic probe comprising a connection change over switch disposed in a handle section of the probe, wherein the connection change over switch is constituted in such a manner that a respective plurality of the vibrator elements are connectable with any one of a predetermined number of ultrasonic wave transmission and reception channels for transmitting and receiving ultrasonic wave signals in an ultrasonic diagnostic apparatus main body, and the connection change over switch successively changes over electrical connection of a predetermined number of vibrator elements among the plurality of vibrator elements to be connected with the predetermined number of ultrasonic wave transmission and reception channels, as provided by the subject matter of claim 1.

Should the Examiner disagree therewith, applicant request that the Examiner indicate the specific language in Hossack which the Examiner equates with the such claim features.

O'Donnell, as understood by Applicant, proposes an approach for performing ultrasound imaging wherein the ultrasonic imaging system produces simultaneously, and samples, three receive beams for each transmitted ultrasonic pulse directed upon flowing reflectors, flow

velocity is measured in the cross range direction using a correlation technique while flow velocity in the range direction is simultaneously measured using a Doppler method, and cross correlation is performed in both the range and cross range directions with data acquired from a set of such multi-beam acquisitions, in order to produce a B-scan image which indicates both magnitude and direction of the flowing reflectors.

O'Donnell was cited in the Office Action only against dependent claims in the application.

Applicant does not find teaching or suggestion in the cited art, however, of an ultrasonic probe comprising a connection change over switch disposed in a handle section of the probe, wherein the connection change over switch is constituted in such a manner that a respective plurality of the vibrator elements are connectable with any one of a predetermined number of ultrasonic wave transmission and reception channels for transmitting and receiving ultrasonic wave signals in an ultrasonic diagnostic apparatus main body, and the connection change over switch successively changes over electrical connection of a predetermined number of vibrator elements among the plurality of vibrator elements to be connected with the predetermined number of ultrasonic wave transmission and reception channels, as provided by the subject matter of claim 1.

Independent claim 2 is patentably distinct from the cited art for at least similar reasons.

Accordingly, for at least the above-stated reasons, Applicant respectfully submits that independent claims 1 and 2, and the claims depending therefrom, are patentable over the cited art.

In view of the amendments to the claims and remarks hereinabove, Applicant submits that the application is now in condition for allowance. Accordingly, Applicant earnestly solicits

the allowance of the application.

If a petition for an extension of time is required to make this response timely, this paper should be considered to be such a petition. The Patent Office is hereby authorized to charge any fees that are required in connection with this amendment and to credit any overpayment to our Deposit Account No. 03-3125.

If a telephone interview could advance the prosecution of this application, the Examiner is respectfully requested to call the undersigned attorney.

Respectfully submitted,

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EXHIBIT A

to
AMENDMENT
(Serial No. 10/563,086)

EXHIBIT B

to
AMENDMENT
(Serial No. 10/563,086)